Freescale Semiconductor
User's Guide

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KITPF0200EPEVBE Evaluation Board

Featuring the MMPF0200 12-Channel Configurable PMIC

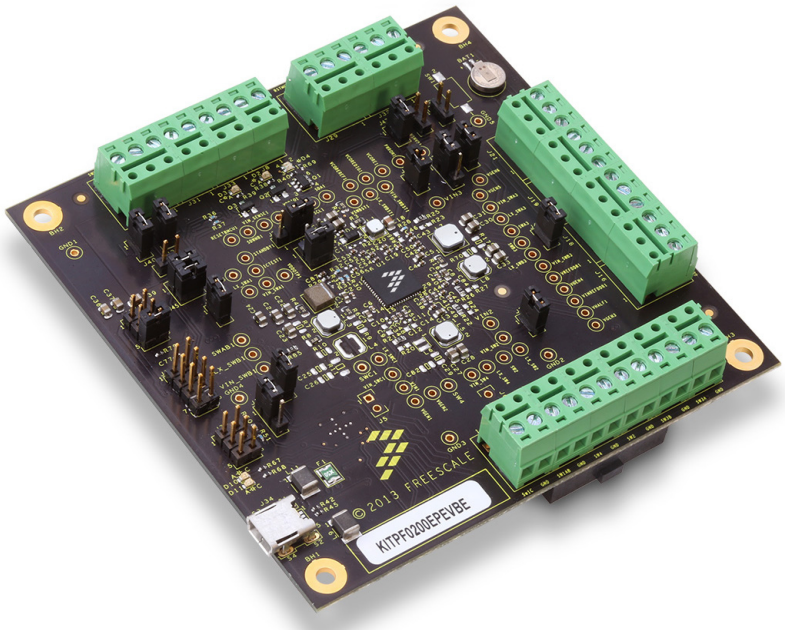

Figure 1. KITPF0200EPEVBE Evaluation Board

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1 Kit Contents / Packing List

- KITPF0200EPEVBE evaluation board
- KITPF0200QSG Quick Start Guide
- Warranty card and Technical support brochure

2 Jump Start

- Go to www.freescale.com/analogtools
- Locate your kit
- Review your Tool Summary Page
- Look for

- Download documents, software, and other information

3 Important Notice

Freescale provides the enclosed product(s) under the following conditions:

This evaluation kit is intended for use of ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY. It is provided as a sample IC pre-soldered to a printed circuit board to make it easier to access inputs, outputs, and supply terminals. This EVB may be used with any development system or other source of I/O signals by simply connecting it to the host MCU or computer board via off-the-shelf cables. This EVB is not a Reference Design and is not intended to represent a final design recommendation for any particular application. Final device in an application will be heavily dependent on proper printed circuit board layout and heat sinking design as well as attention to supply filtering, transient suppression, and I/O signal quality.

The goods provided may not be complete in terms of required design, marketing, and or manufacturing related protective considerations, including product safety measures typically found in the end product incorporating the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. In order to minimize risks associated with the customers applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards. For any safety concerns, contact Freescale sales and technical support services.

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4 Introduction

The KITPF0200EPEVBE evaluation board allows full evaluation capability of the MMPF0200 PMIC for the i.MX family of application processors. It provides access to all output voltage rails as well as control and signal pins through terminal block connectors for an easier out-of-the-box evaluation experience. A single terminal block connector for the input power supply allows the user to supply the board with an external DC power supply to fully evaluate the performance of the device.

The KITPF0200EPEVBE comes with a non-programmed version of the MMPF0200 PMIC, and it is configured to power up from the default power-up sequence. However, an integrated control/fuse programming interface is provided to allow the customer to program the OTP/TBB (One Time Programmable/Try-Before-Buy) memory and select it as the default source for the power-up configuration. Likewise, the programming interface allows full control of the MMPF0200 through the I^2C communication lines.

This document is intended to provide the hardware description of the KITPF0200EPEVBE evaluation board.

5 Evaluation Board Features

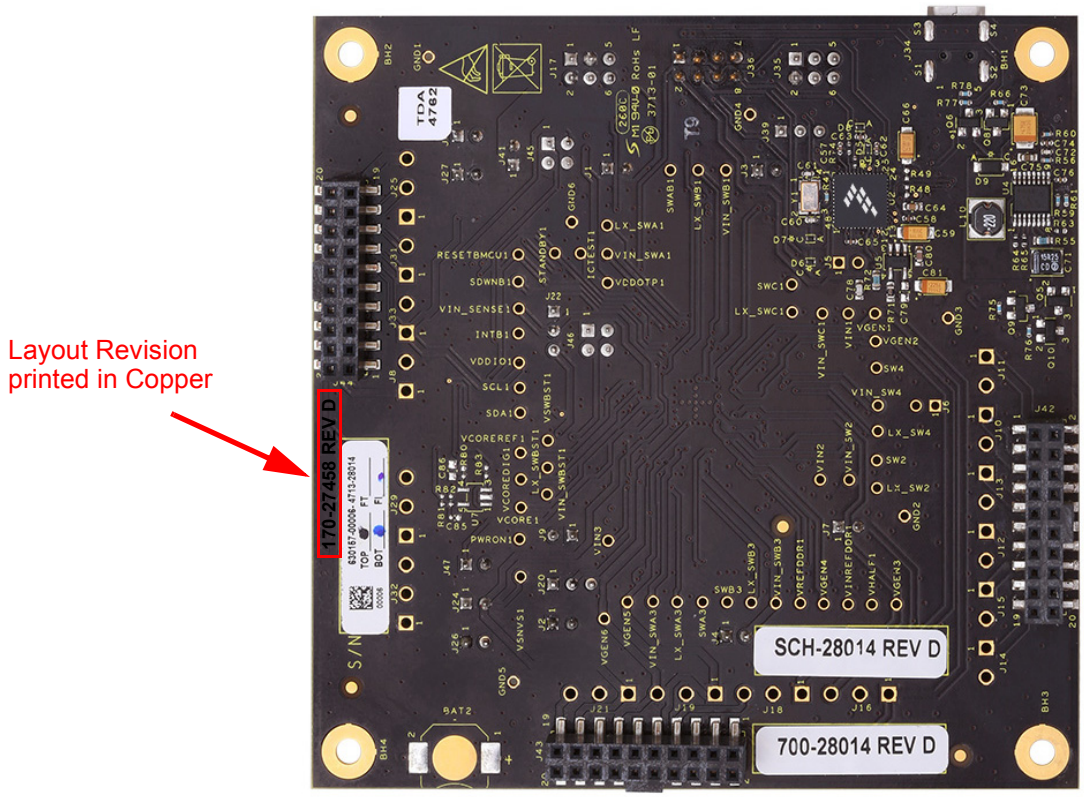
- Input voltage operation range from 3.1 to 4.5 V
- Output voltage supplies accessible through detachable terminal blocks
  - Three to four independent buck converters
  - One 5.0 V boost regulator
  - Six general purpose LDO regulators
  - One DDR memory termination voltage reference
  - One VSRTC supply
- Coin cell support for “Try-Before-Buy” (TBB) mode
- On/off push button support
- Hardware configuration flexibility through various jumper headers and resistors
- Integrated USB to I^2C programming interface for full control/configuration
  - Onboard OTP programming supply and control
  - Onboard PMIC control through the I^2C register map
  - Fully featured programmer through J36 for external device control/programming
- On board connectors for interfacing with future evaluation/debug tools
- Compact form factor (4 x 4 in^2)

5.1 Board Identification

The KITPF0200EPEVBE evaluation board is designed to be used along with the KITPFGUI 4.0 Graphical User Interface. Table 1 provides a list of all available versions of this board and the respective software compatibility and marking differences. The hardware configuration outlined in this document is valid for layout REV D and schematic Rev D.

Table 1. Board Deviation Summary

Board Name	Layout Revision (170-27458)	Hardware deviations	Software Version	Software User Guide
KITPF0200EPEVBE	Rev D	-	KITPFGUI 4.0 – release 4.0.0.x	Refer to Document KTPFSWUG4.pdf


Layout Revision
printed in Copper
170-27458 REV D
SCH-28014 REV D
700-28014 REV D

6 MMPF0200NPAEP Device Features

The MMPF0200 is highly integrated power management IC ideally suited i.MX 6 series of applications processors. It features the following:

- Four buck regulators
- Boost regulator to 5.0 V output
- Six general purpose linear regulators
- Programmable output voltage, sequence, and timing
- OTP (One Time Programmable) memory for device configuration
- Coin cell charger and RTC supply
- DDR termination reference voltage
- Power control logic with processor interface and event detection

Freescale analog ICs are manufactured using the SMARTMOS process, a combinational BiCMOS manufacturing flow that integrates precision analog, power functions, and dense CMOS logic together on a single cost-effective die.

7 MC9508JM60 Device Features

The KITPF0200EPEVBE implements a Freescale MC9S08JM60 low-cost, high-performance 8-bit HCS08 microcontroller to interface via USB to I2C to control the main PMIC.

8-bit HCS08 Central Processing Unit (CPU)

- Up to 24 MHz internal bus (48 MHz HCS08 core) frequency offering 2.7 to 5.5 V across temperature range of -40 to +85 °C
- Support for up to 32 peripheral interrupt/reset sources

On-Chip Memory

- Up to 60 K flash read/program/erase over full operating voltage and temperature
- Up to 4 K RAM
- 256 Byte USB RAM

8 Required Equipment

8.1 Hardware Requirements

- Power supply:
  - Output voltage range from 3.1 to 4.5 V
  - Current capability from 3.0 to 5.0 A (current requirement is dependent on output loading)
- Supply to board connection cables (capable of withstanding up to 5.0 A current)
- USB (male) to mini USB (male) communication cable.
- USB-enabled computer.
- Multimeter

8.2 Software Requirements

- Windows XP or Windows 7 operating system
- KITPFGUI 4.0.zip: Graphical User Interface (GUI) for KITPF0200EPEVBE
- Refer to document KTPFSWUG4.PDF located at Freescale.com for detailed instruction on software installation and control.

9 Evaluation Board Configuration

Connect the power supply and the USB communication cables as shown in Figure 2. Voltmeters are optional but they are recommended to accurately verify that each one of the output supplies provides the correct voltage level.

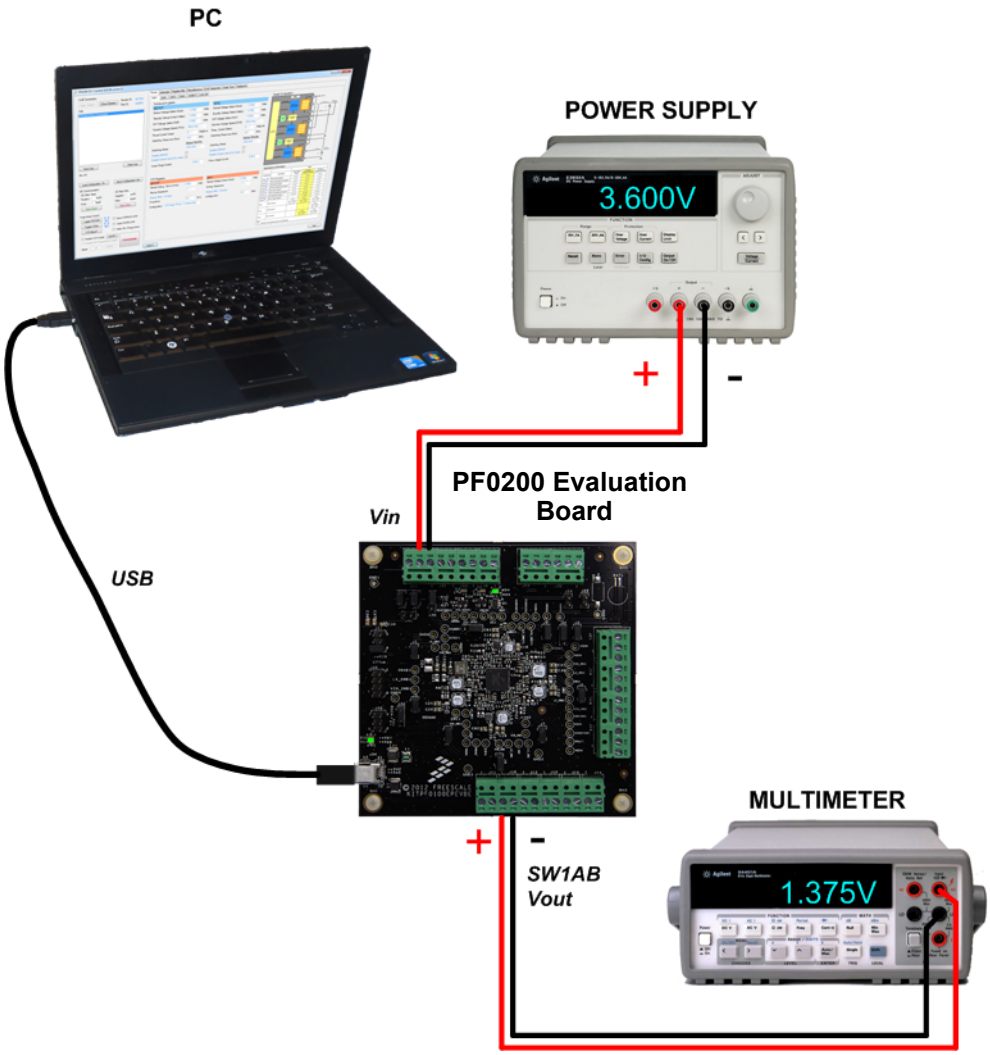


Figure 2. Evaluation Board Setup

Note: The KITPF0200EPEVBE allows the selection of an SW2 regulator output or an external 3.3 V LDO output as the V_{DDIO}/I^2C pull-up supply. By default, the SW2 regulator is the source for the V_{DDIO} supply (J30 = 3-2). If the SW2 regulator is to be set below 3.0 V, then make sure the 3.3 V LDO output is connected to V_{DDIO} and the I^2C pull-up resistors by removing R34 and R33 and the shorting pins 1, 2, and 3 of J30.

9.1 Hardware Configuration

By default, the KITPF0200EPEVBE evaluation board is set to power-up from the default power-up sequence. Verify that the jumpers are placed in the right position as shown in Figure 3. For a detailed description of the jumper functionality, refer to Table 2.

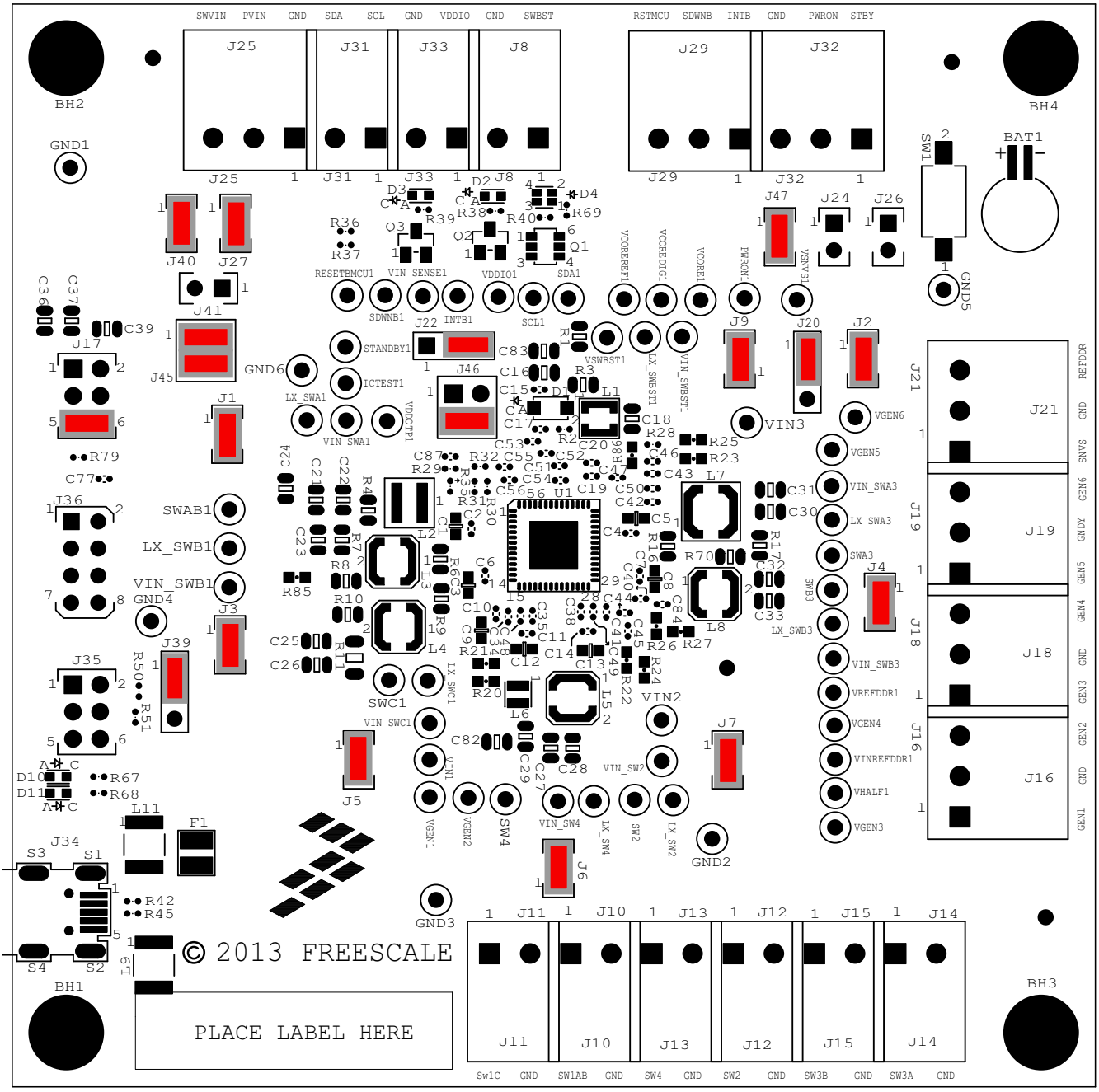


Figure 3. Default Jumper Configuration Diagram

9.2 Hardware Description

The KITPF0200EPEVBE operates with a single power supply from 3.1 to 4.5 V and is controlled via USB with the help of an integrated USB-I^2C communication bridge. By applying the input voltage supply, the KITPF0200EPEVBE will power-up according to the default power-up sequence described in the MMPF0200 datasheet. For controlling the MMPF0200 device or programming the OTP registers, refer to the KTPFSWUG4.PDF user guide.

Important notice: If power-up sequences and configuration are to be modified, the user must ensure that the register settings are consistent with the hardware configuration. This is most important for the buck regulators, where the quantity, size, and value of the inductors depend on the configuration (single/dual phase or independent mode) and the switching frequency. Additionally, if an LDO is powered by a buck regulator, it will be gated by the buck regulator in the start-up sequence. Refer to the MMPF0200 Data Sheet for details on buck regulator setup.

9.3 Jumper Description

Table 2. KITPF0200EPEVBE Jumper Description

Jumper	Default	Description
J1 - J7	Closed	Buck regulators input power path isolation. Short these jumpers to allow SWxIN to be powered from the SWVIN supply.
J9	Closed	SWBST regulator input power path isolation. Short this jumper to allow SWBSTIN to be powered from the SWVIN supply.
J17	5-6	VDDOTP Supply selector • 1-2: Connect VDDOTP to the OTP Boost output (VDDOTPIN) for OTP programming. • 3-4: Connect VDDOTP to GND to power-up from OTP/TBB sequence. • 5-6: Connect VDDOTP to VCOREDIG to power up from Default Power-up sequence.
J20	1-2	Coin cell selector. • 1-2: Enables BAT1 as the main coin cell supply. • 2-3: Enables BAT2 as the main coin cell supply.
J40	Closed	Shorts PVIN and SWVIN. Allows supply isolation to provide more accurate efficiency readings on the switching supplies.
J41	Open	Shorts SWVIN to VIN. Allows one to isolate or connect the MMPF0200 logic input supply to SWVIN net. (debugging option)
J27	Closed	Shorts PVIN to VIN. Allows one to isolate or connect the MMPF0200 logic input supply to PVIN net. (debugging option)
J22	2-3	MMPF0200 input logic supply selector. • 1-2: Connects MMPF0200 VIN pin to the 3.3 V external LDO regulator for debugging purposes. • 2-3: Connects MMPF0200 VIN pin to the main input supply. Refer to Figure 13.
J26	Open	Short to hold PWRON pin low.
J24	Open	Short to pull STANDBY to VSNVS voltage supply.
J47	Close	Connects PWRON pin on the MMPF0200 to an I/O on the MCU.
J45	1-2 3-4	Allows I^2C signal isolation on the local MMPF0200 when the KITPF0200EPEVBE is used as an external programmer.

Table 2. KITPF0200EPEVBE Jumper Description (continued)

Jumper	Default	Description
J46	3-4	VDDIO supply / I^2C pull-up supply selector • 1-2: Pull the SCL/SDA signals to the external 3.3 V LDO regulator output. • 3-4: Pull the SCL/SDA signals to SW2 output. NOTE: Do not connect both positions at the same time.
J39	1-2	Control Interface input supply selector • 1-2: Enables PVIN node as the input supply source for the control interface. • 2-3: Enables USB power as the input supply source for the control interface.

9.4 Connectors and Terminal Blocks Description

Table 3. Terminal Blocks descriptions

Connector	Function	Pin definition
J8	SWBST	Pin 1 - SWBST Output Pin 2 - GND
J10	SW1AB	Pin 1 - SW1AB Output Pin 2 - GND
J11	Not Available	Reserved for board compatibility
J12	SW2	Pin 1 - SW2 Output Pin 2 - GND
J13	Not Available	Reserved for board compatibility
J14	SW3A	Pin 1 - SW3A Output Pin 2 - GND
J15	SW3B	Pin 1 - SW3B Output Pin 2 - GND
J16	VGEN1/VGEN2	Pin 1 - VGEN1 Output Pin 2 - GND Pin 3 - VGEN2 Output
J18	VGEN3/VGEN4	Pin 1 - VGEN3 Output Pin 2 - GND Pin 3 - VGEN4 Output
J19	VGEN5/VGEN6	Pin 1 - VGEN5 Output Pin 2 - GND Pin 3 - VGEN6 Output
J21	VSNVS/VREFDDR	Pin 1 - VSNVS Output Pin 2 - GND Pin 3 - VREFDDR Output
J25	Main Input Supply	Pin 1 - GND Pin 2 - PVIN Pin 3 - SWVIN
J29	Interfacing 1	Pin 1 - INTB Pin 2 - SDWNB Pin 3 - RESETBMCU
J32	Interfacing 2	Pin 1 - STANDBY Pin 2 - PWRON Pin 3 - GND

Table 3. Terminal Blocks descriptions (continued)

Connector	Function	Pin definition
J31	I^2C Signals	Pin 1 - SCL Pin 2 - SDA
J33	VDDIO	Pin 1 - VDDIO Pin 2 - GND

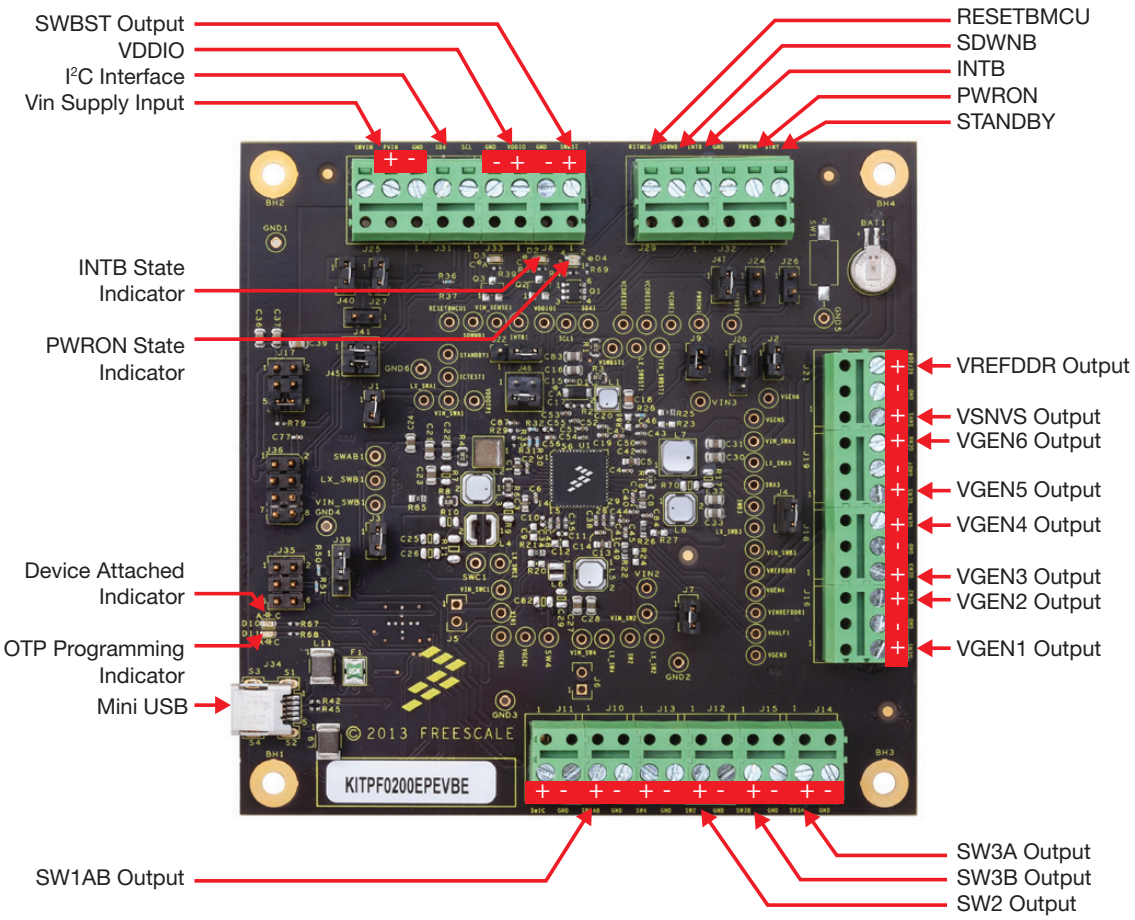
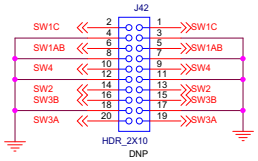
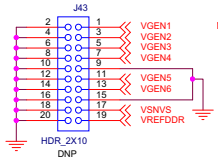
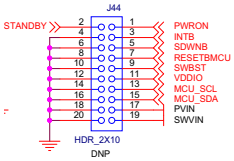


Figure 4. Input/Output Terminal Blocks

Table 4. Connector Description

Connector	Function	Pin definition
J34	Mini USB connector	Pin 1 - VBUS Pin 2 - D- Pin 3 - D+ Pin 4 - NC Pin 5 - GND Chassis - GND
J35	BDM connector	Pin 1 - BKGD_JM60 Pin 2 - GND Pin 3 - NC Pin 4 - RST_JM60 Pin 5 - NC Pin 6 - USB_PWR
J36	Programmer connector	Pin 1 - VDDOTPIN (8.5 V boost output) Pin 2 - 3V3 (3.3 V LDO output) Pin 3 - GND Pin 4 - MCU_SCL (I^2C clock signal) Pin 5 - MCU_SDA (I^2C data signal) Pin 6 - PWRON (Controls the PWRON on the target device) Pin 7 - GPIO 1 (General Purpose GPIO) Pin 8 - GPIO 2 (General Purpose GPIO)
J42	Debug Port 1	Debugging connector for future development tools. 
J43	Debug Port 2	Debugging connector for future development tools 
J44	Debug Port 3	Debugging connector for future development tools 

9.5 Debug and Configuration Components

The KITPF0200EPEVBE allows full flexibility to change the default configuration of SW1A/B and SW3A/B outputs to a more suitable configuration for a specific application. It also provides several source options for the LDO supplies to test various loading and supplying scenarios.

Test point are provided on key nodes of the KITPF0200EPEVBE to allow full debugging capability during application development.

9.5.1 SW1A/B Configuration Components

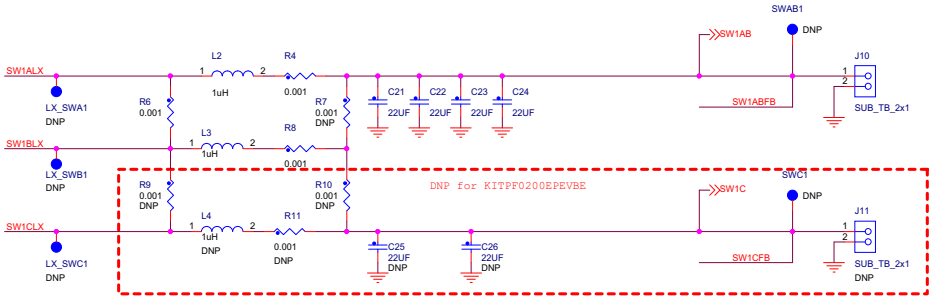


Figure 5. SW1A/B/C Output Configuration

The SW1A/B regulator can be configured in various operating modes as described in Table 5.

Table 5. SW1AB Configuration Chart

Component	SW1A/B Single phase	SW1A/B Dual phase
R6	Closed	DNP
R4	Closed	Closed
R7	DNP	Closed
R8	DNP	Closed
L2	1.0 µH ISAT = 4.5 A	1.0 µH ISAT = 2.4 A
L3	N/A	1.0 µH ISAT = 2.4 A
L4	RESERVED	RESERVED
R9	RESERVED	RESERVED
R11	RESERVED	RESERVED
R10	RESERVED	RESERVED

9.5.2 SW3A/B Configuration Components

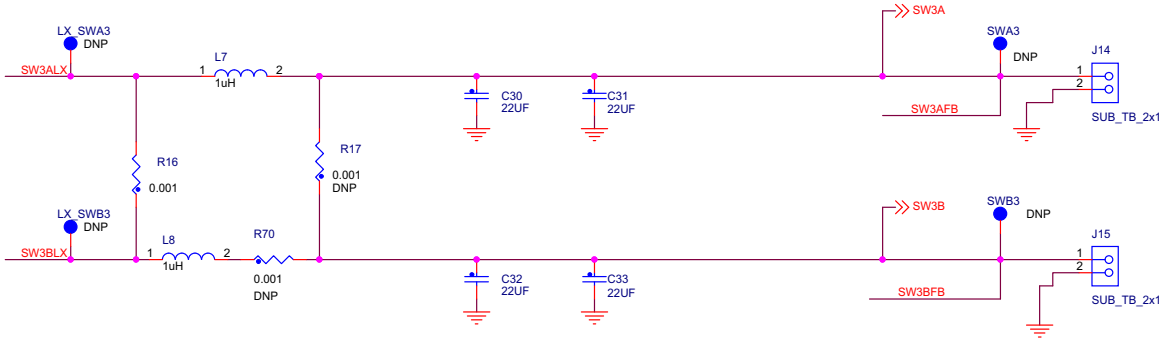


Figure 6. SW3A/B Output Configuration

The SW3A/B regulator can be configured in various operating modes as described in Table 6.

Table 6. SW3ABC Configuration Chart

Component	SW3A/B Single phase	SW3A/B Dual phase	SW3A Independent SW3B Independent
R16	Closed	DNP	DNP
R17	Closed	Closed	DNP
R70	DNP	Closed	Closed
L7	1.0 µH ISAT = 3.9 A	1.0 µH ISAT = 3.0 A	1.0 µH ISAT = 3.0 A
L8	N/A	1.0 µH ISAT = 3.0 A	1.0 µH ISAT = 3.0 A

9.5.3 LDO Input Supply Source Selection

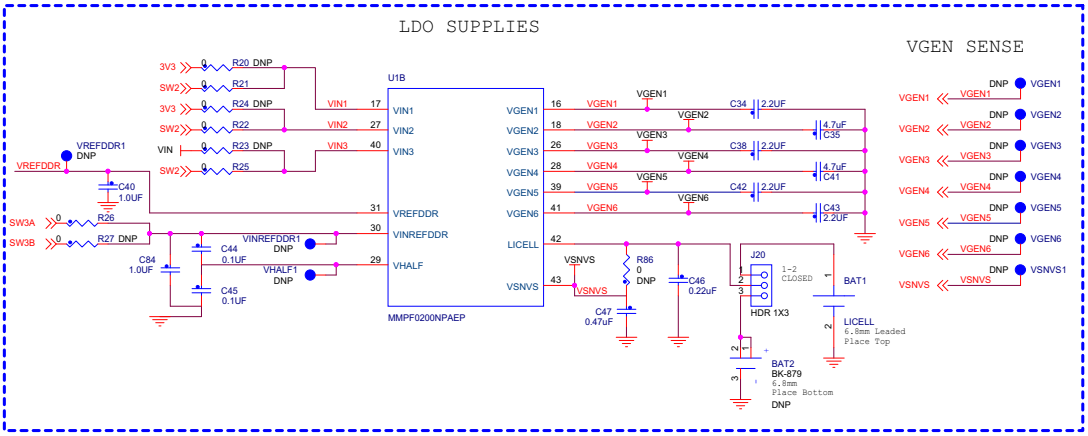


Figure 7. LDO Schematic Configuration

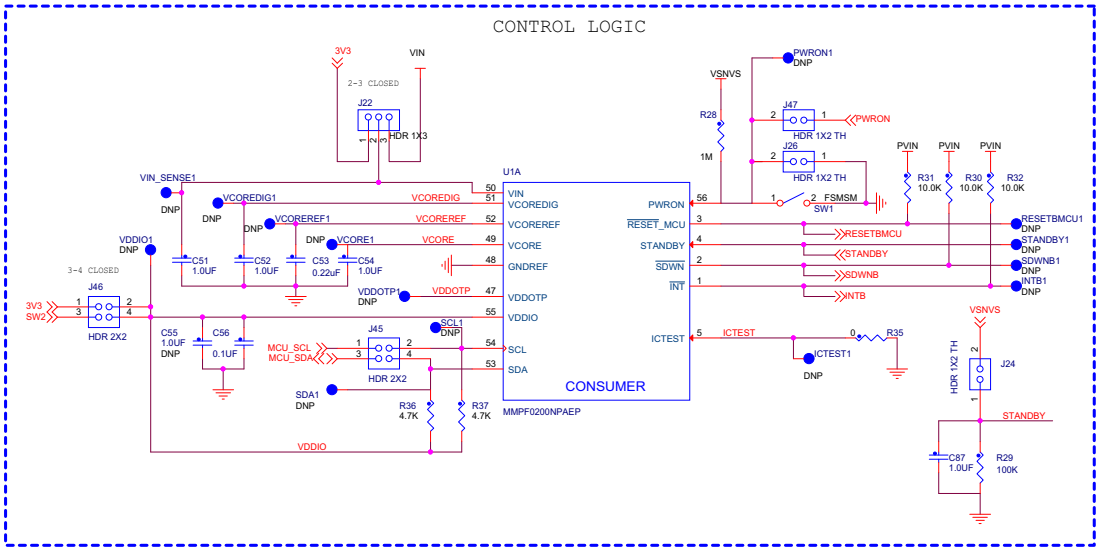


Figure 8. Logic and Core Supplies Schematic

Table 7. LDO Input Supply Configuration Chart

Input Pin	Input options
VIN1	Input supply for VGEN1 and VGEN2 R20 = External 3.3 V Supply R21 = SW2
VIN2	Input supply for VGEN3 and VGEN4 R24 = External 3.3 V Supply R22 = SW2
VIN3	Input supply for VGEN5 and VGEN6 R23 = VIN R25 = SW2
VINREFDDR	VREFDDR input supply R26 = SW3A R27 = SW3B

1. Make sure to populate only one option per input pin to avoid shorts between various sources.

9.5.4 Test Point

All test points are clearly marked on the KITPF0200EPEVBE evaluation board. Figure 9 shows the location of various test points of interest during evaluation.

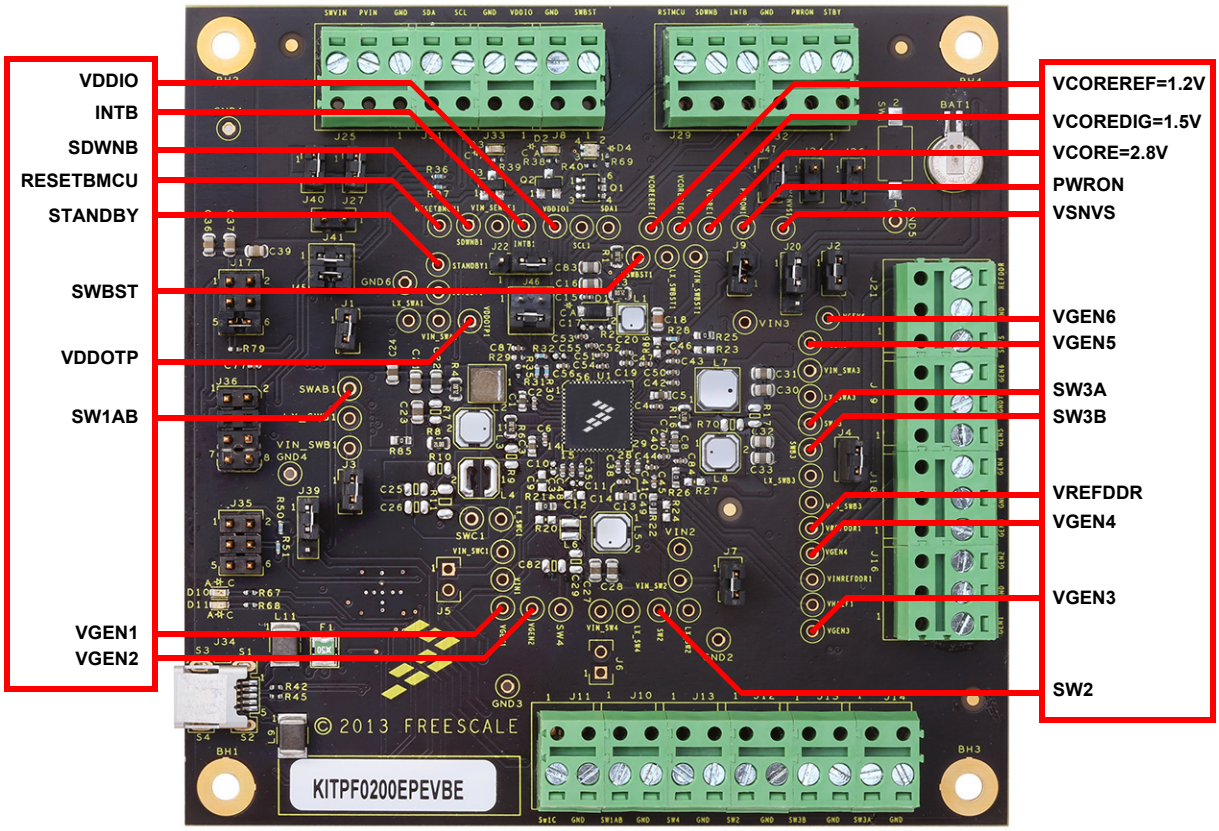


Figure 9. Key Test Point Locations and Default Voltages

9.6 Miscellaneous Components

9.6.1 Power on Push Button

A footprint for a normally open, momentary push-button (SW1) is provided at the PWRON pin to allow a momentary low state by pressing the push button. J47 allows isolation of the PWRON pin from the MCU GPIO controlling this pin, while J26 forces the PWRON pin to ground when closed.

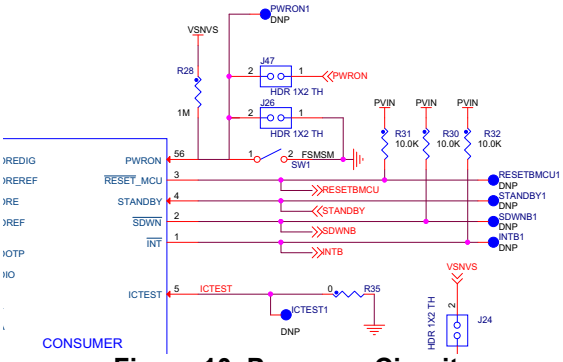


Figure 10. Power on Circuit

9.6.2 PMIC LED Indicators

LED indicators are provided to notify the PMIC status to the user. Figure 11 shows the PMIC status LEDs D2, D3, and D4, to monitor INTB, PWRON, and RESETBMCU signals respectively.

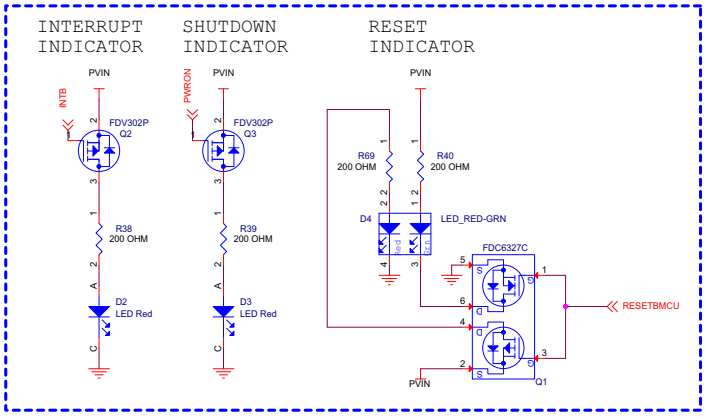


Figure 11. PMIC Status Indicator

Table 8 describes the meaning of the LED states.

Table 8. LED State Description

LED	Description
D2	Interrupt Notification ON = PMIC has detected an unmasked interrupt OFF = No interrupt detected
D4	RESETBMCU Notification Green = PMIC is in regulation and operating properly Red = PMIC is out of regulation
D3	PWRON State ON = PWRON pin is low OFF = PWRON pin is high

9.6.3 Control/Programming Interface

This onboard USB-to-I^2C interface comprises three basic blocks.

1. Controlling MCU (MC9S08JM60CGTE) for USB-I^2C translation.
2. 3.3 V LDO supply for external device controlling.
3. 8.25 V boost converter for OTP programming.

The control/programming interface allows one to program the onboard MMPF0200 PMIC. Alternatively, the interface can serve as a programmer for external devices though the connector J36.

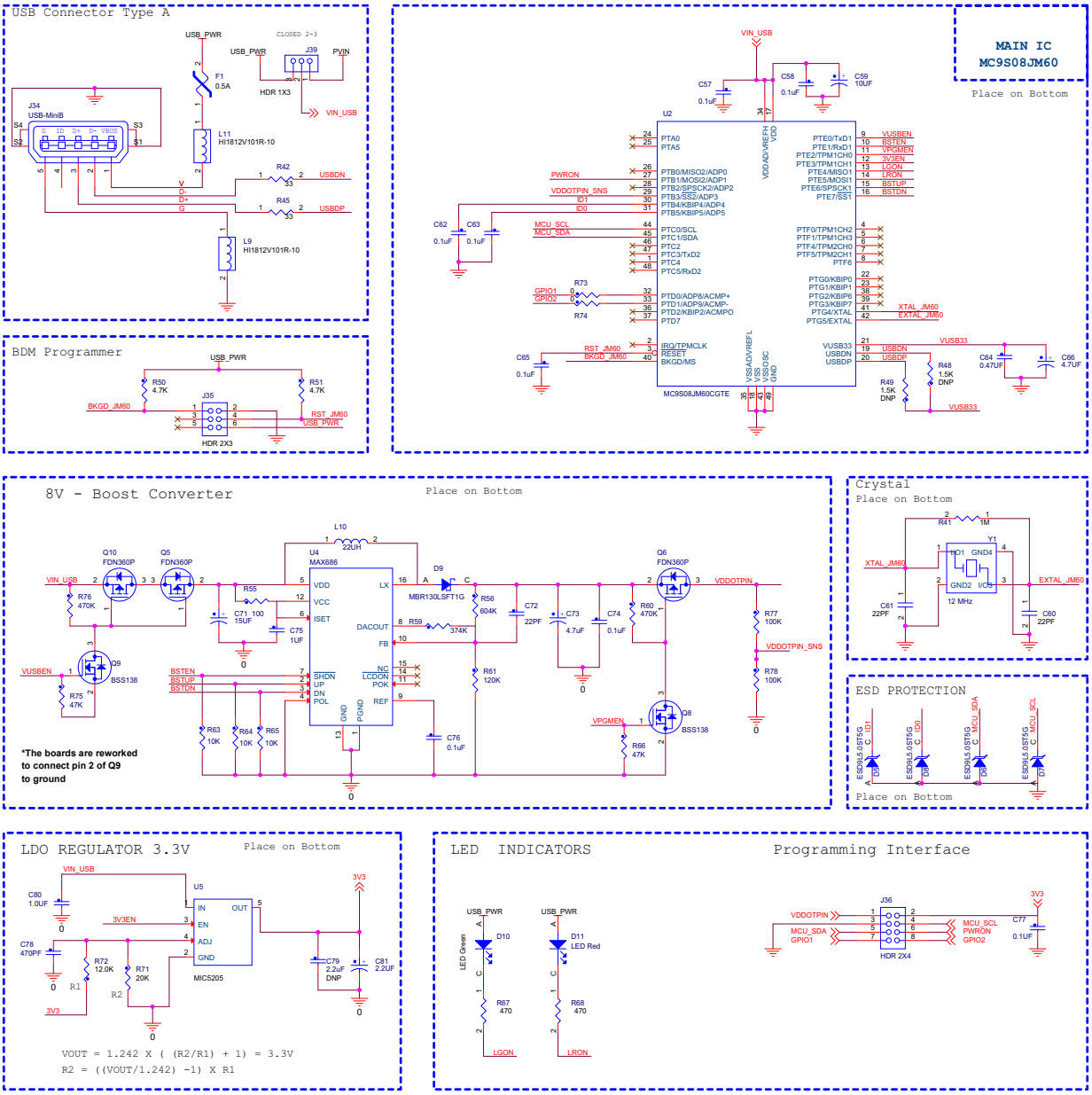


Figure 12. Control/Programming Interface Schematic

9.7 Programming an External MMPF0200 Through J36

If the KITPF0200EPEVBE is used as an external programmer for either a customer board or a dedicated MMPF0200 programming socket, J36 provides the required signals for such a task. However, it will be necessary to isolate the communication signals from the on-board PMIC by doing the following:

1. Remove all jumpers from J22
2. Remove all jumpers from J17
3. Remove all jumpers from J45
4. Remove jumper J47

Note: If it is desired to perform One-Time Programming of the MMPF0200 device soldered on the KITPF0200EPEVBE evaluation board, ensure that the board hardware is correctly configured according to the chosen OTP settings.

The KITPF0200EPEVBE allows the configuration of the SW2 regulator or an external 3.3 V LDO output as the V_{DDIO}/I^2C pull-up supply. By default, the SW2 regulator is the source for the V_{DDIO} supply (J46 = 3-4). If the SW2 regulator is to be set below 3.0 V, then make sure the 3.3 V LDO output is connected to V_{DDIO} and the I^2C pull-up resistors by changing J46 position to 1-2.

10 Evaluation Board Schematic

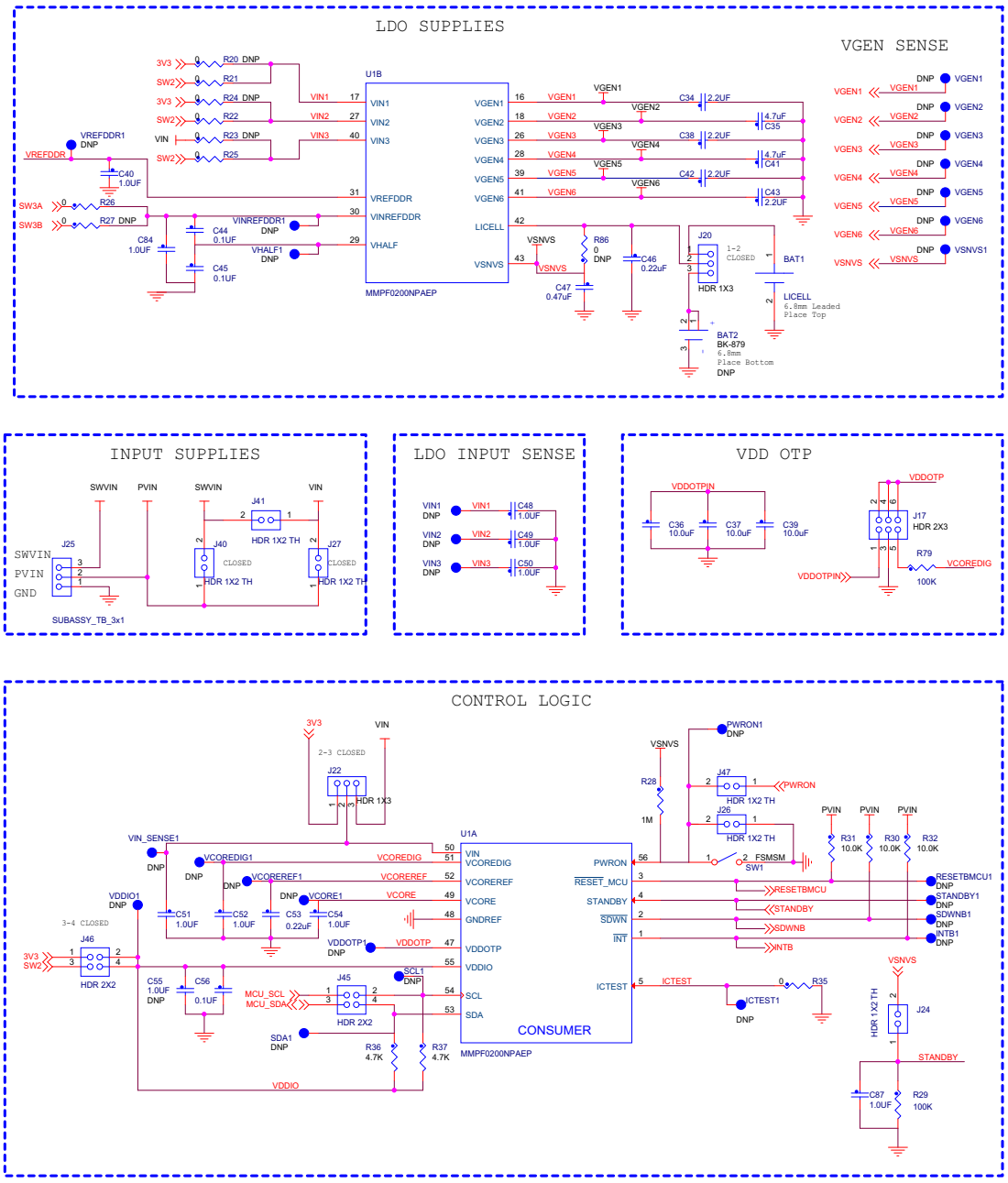


Figure 13. KITPF0200EPEVBE LDO/Control Schematic Part 1

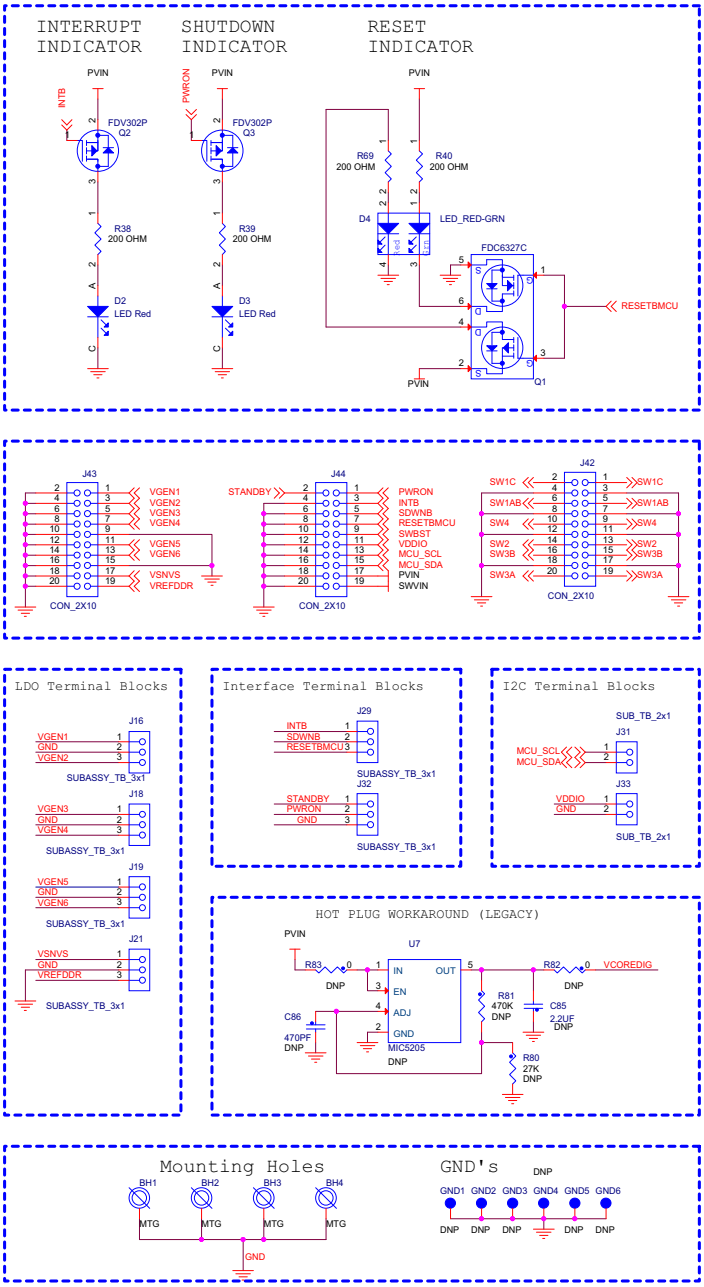


Figure 14. KITPF0200EPEVBE LDO/Control Schematic Part 2

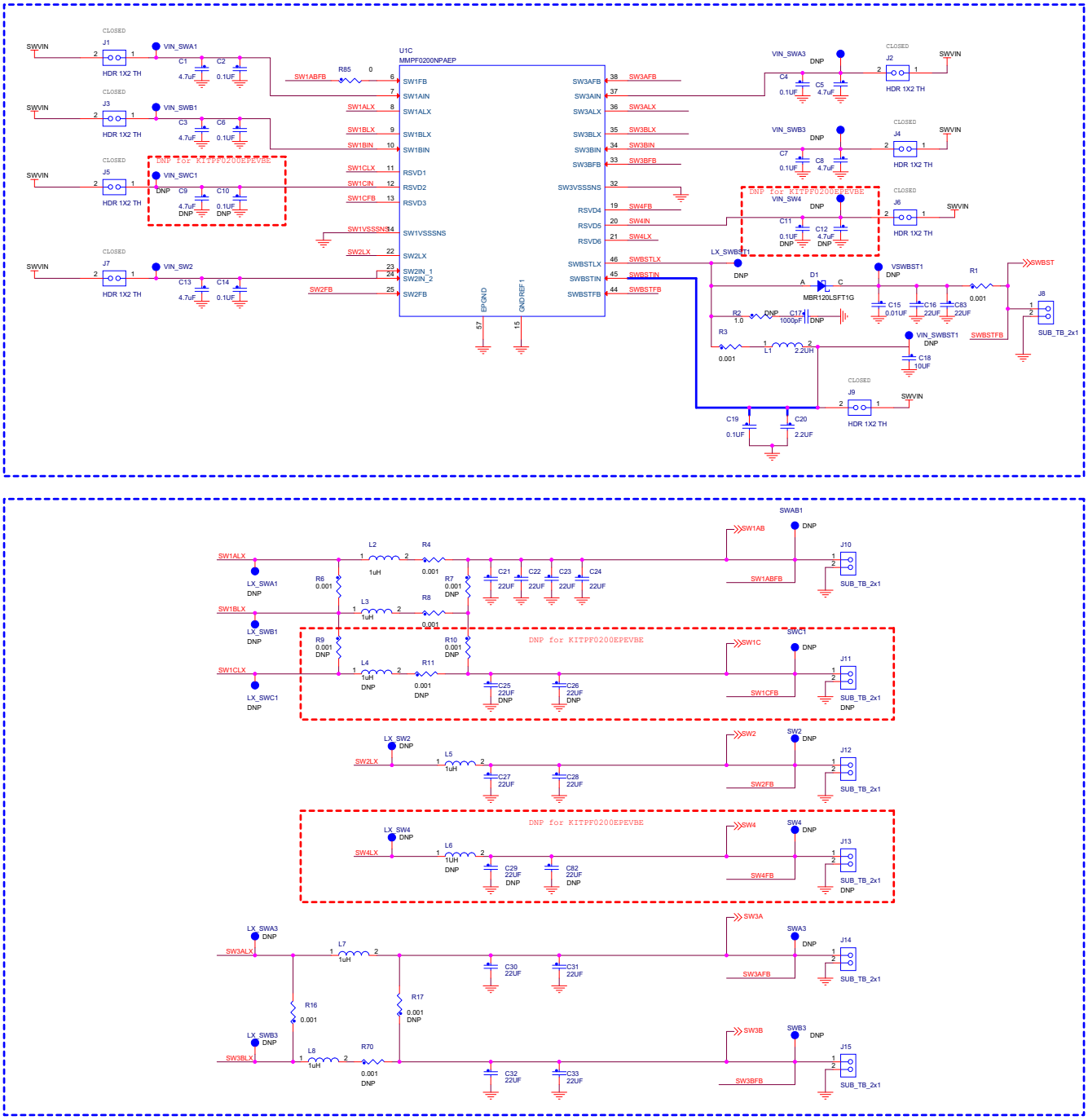


Figure 15. KITPF0200EPEVBE Switching Regulators Schematic

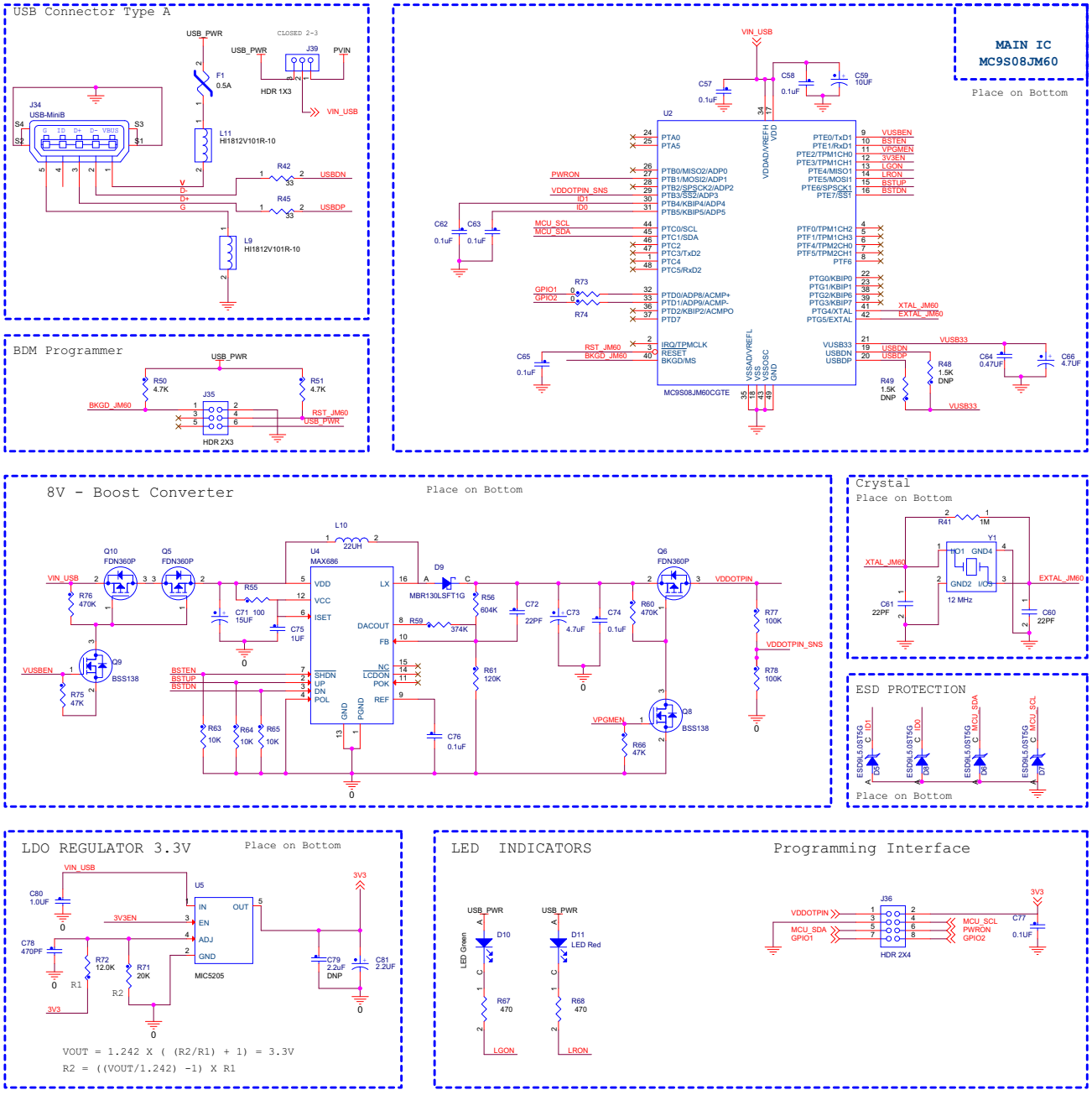


Figure 16. KITPF0200EPEVBE Control/Programming Interface Schematic

11 KITPF0200EPEVBE Board Layout

11.1 Assembly Layer Top

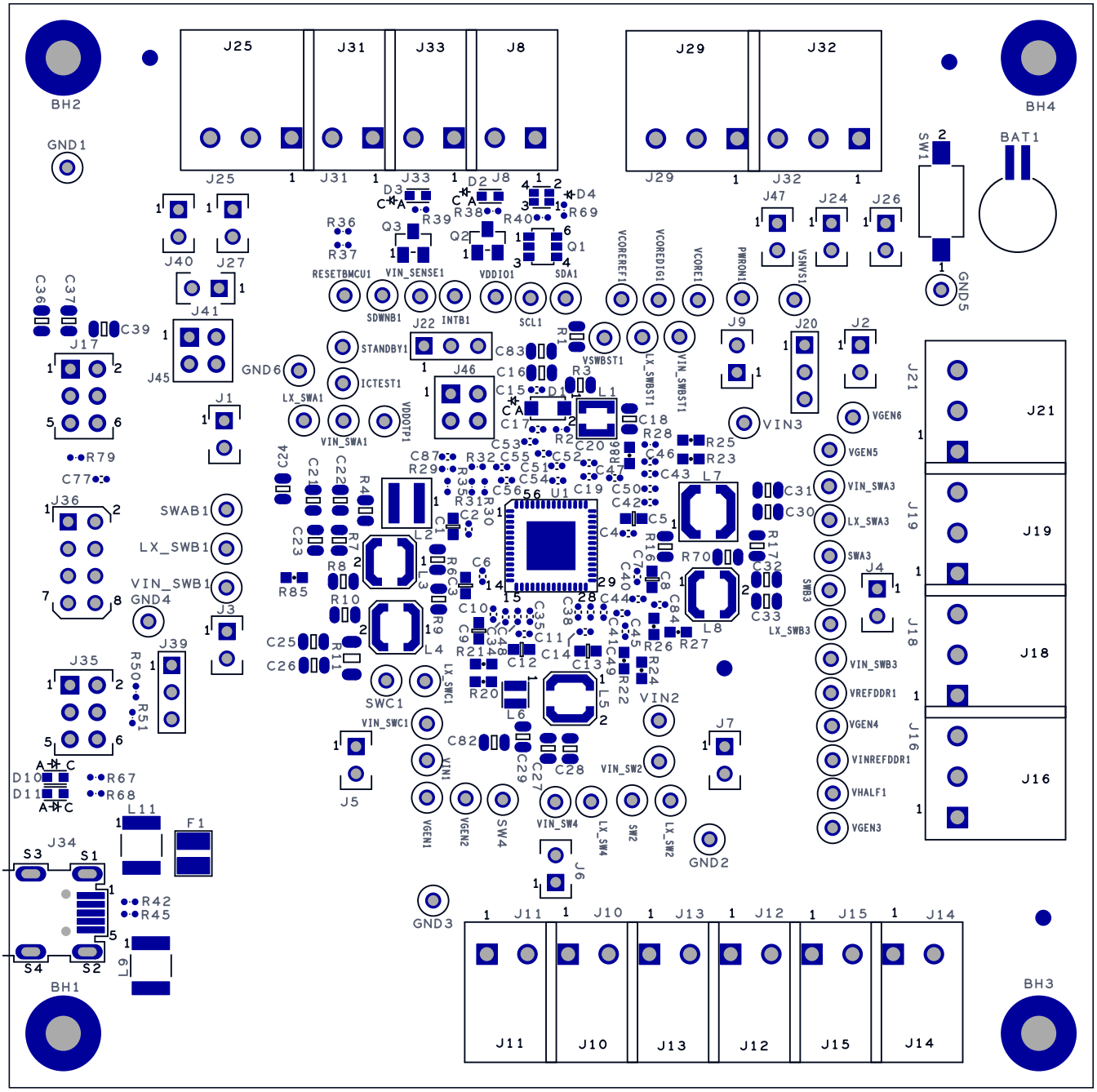


Figure 17. Assembly Top Layer

11.2 Assembly Layer Bottom

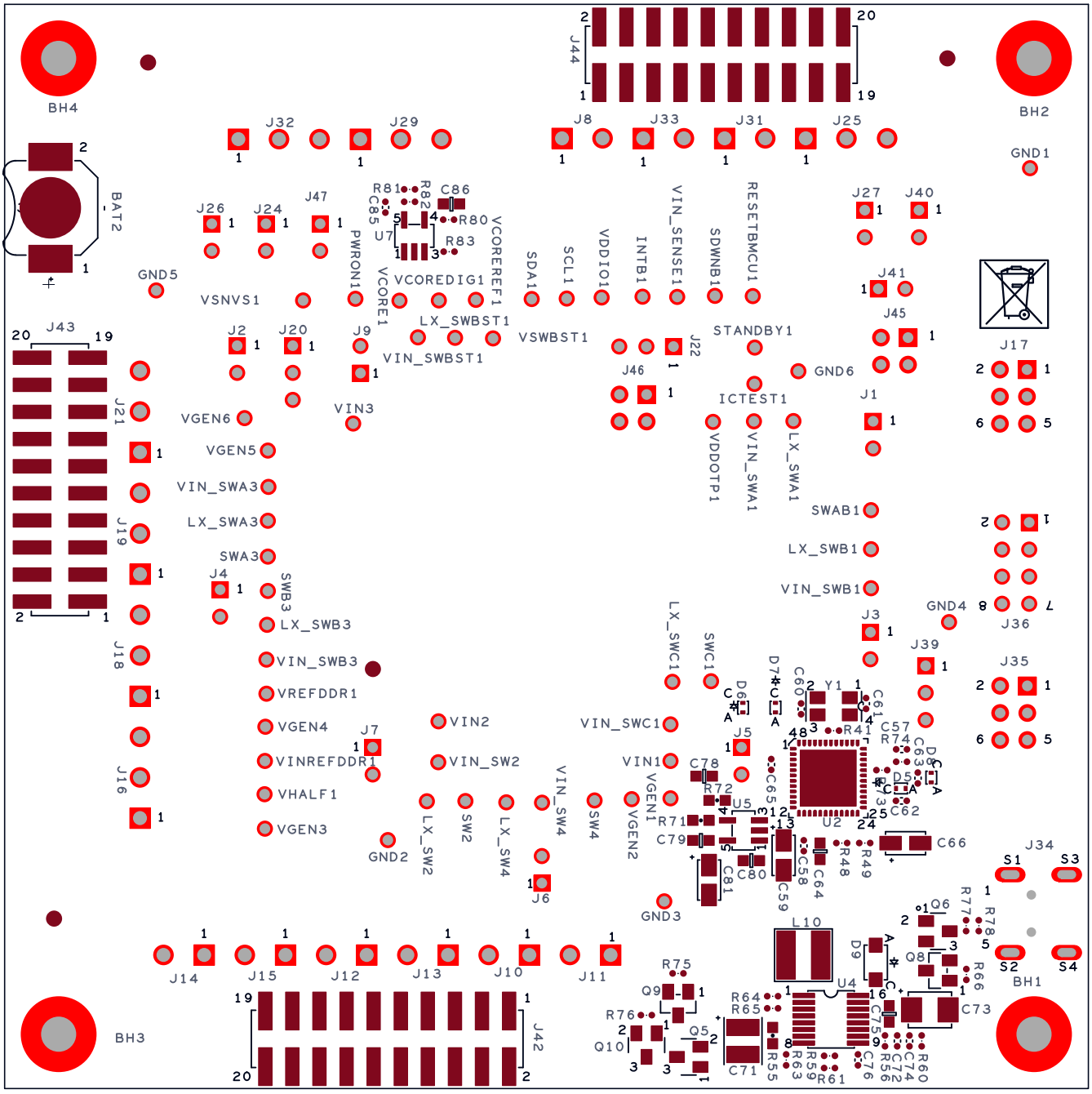


Figure 18. Assembly Layer Bottom

11.3 Top Layer Routing

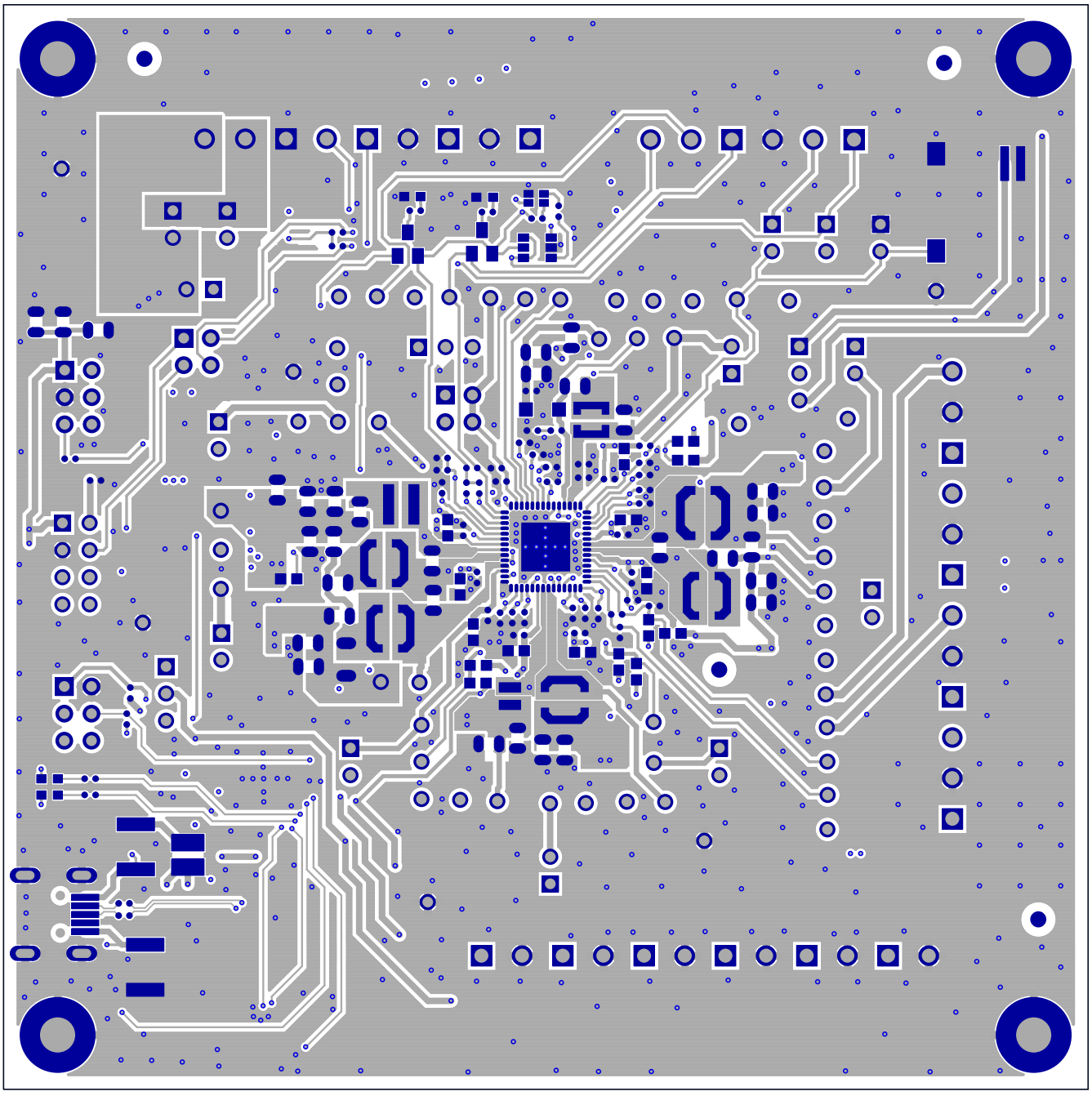


Figure 19. Top Layer Routing

11.4 Inner Layer 1 Routing

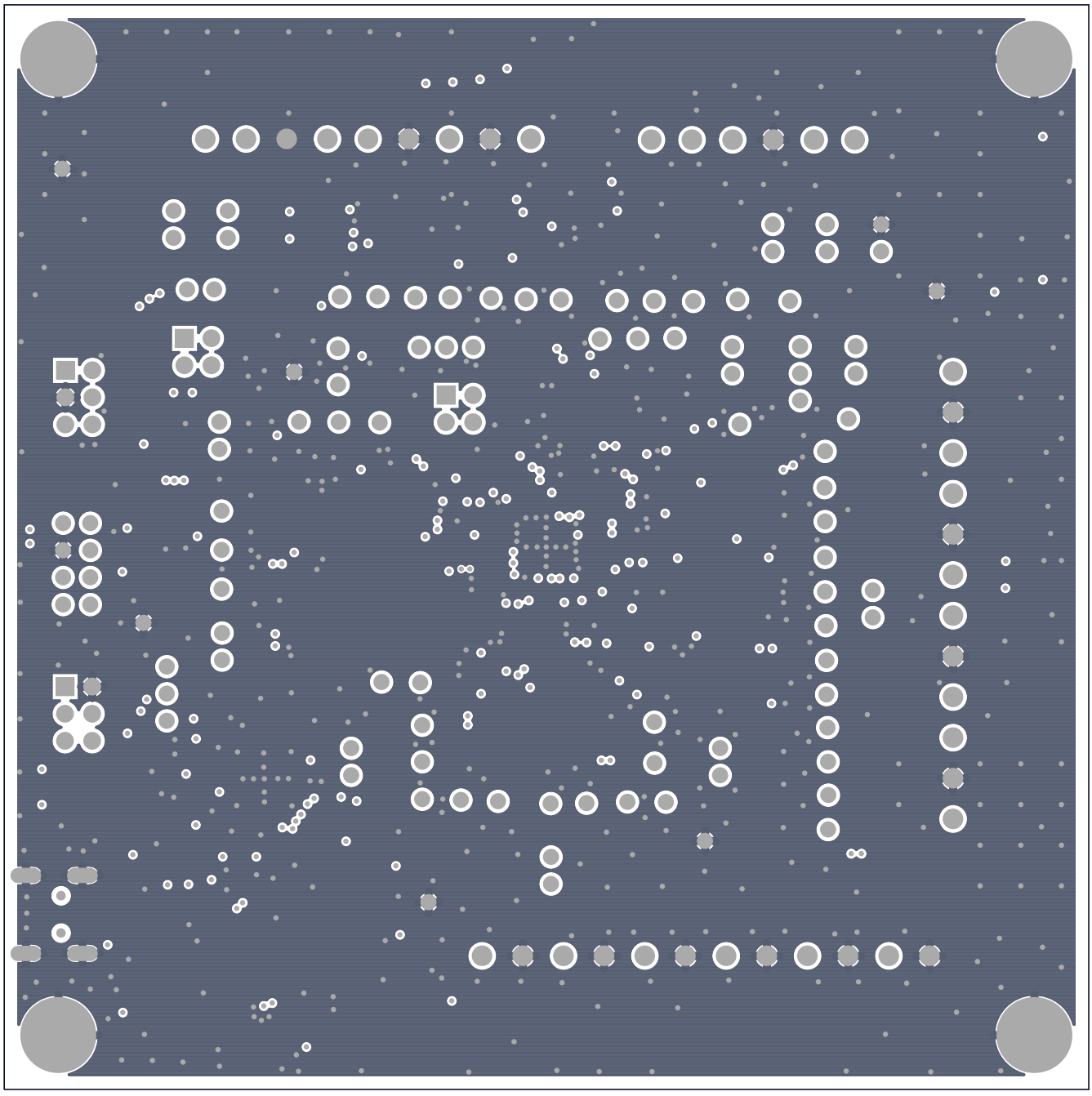


Figure 20. Inner Layer 1 Routing

11.5 Inner Layer 2 Routing

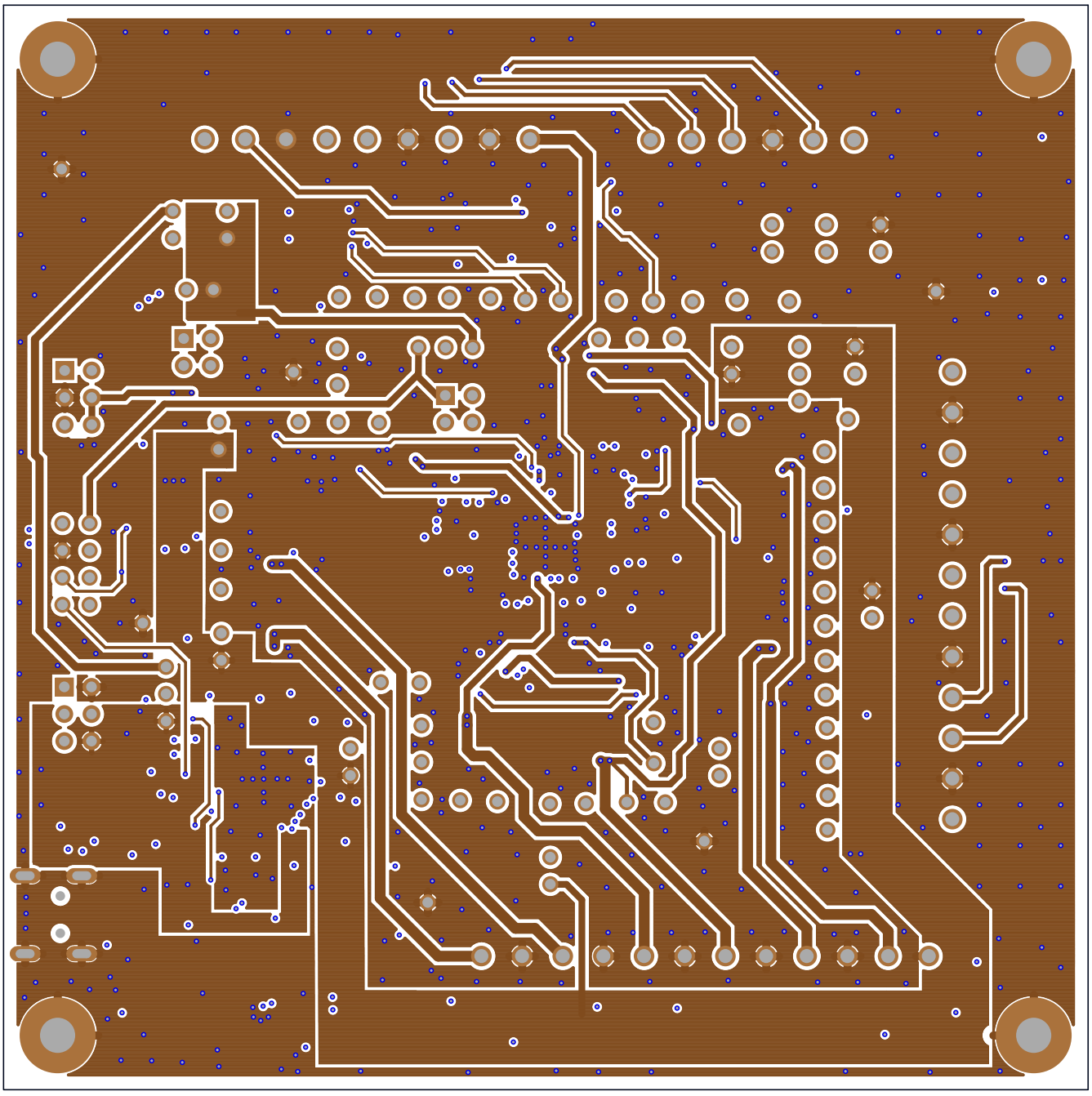


Figure 21. Inner Layer 2 Routing

11.6 Bottom Layer Routing

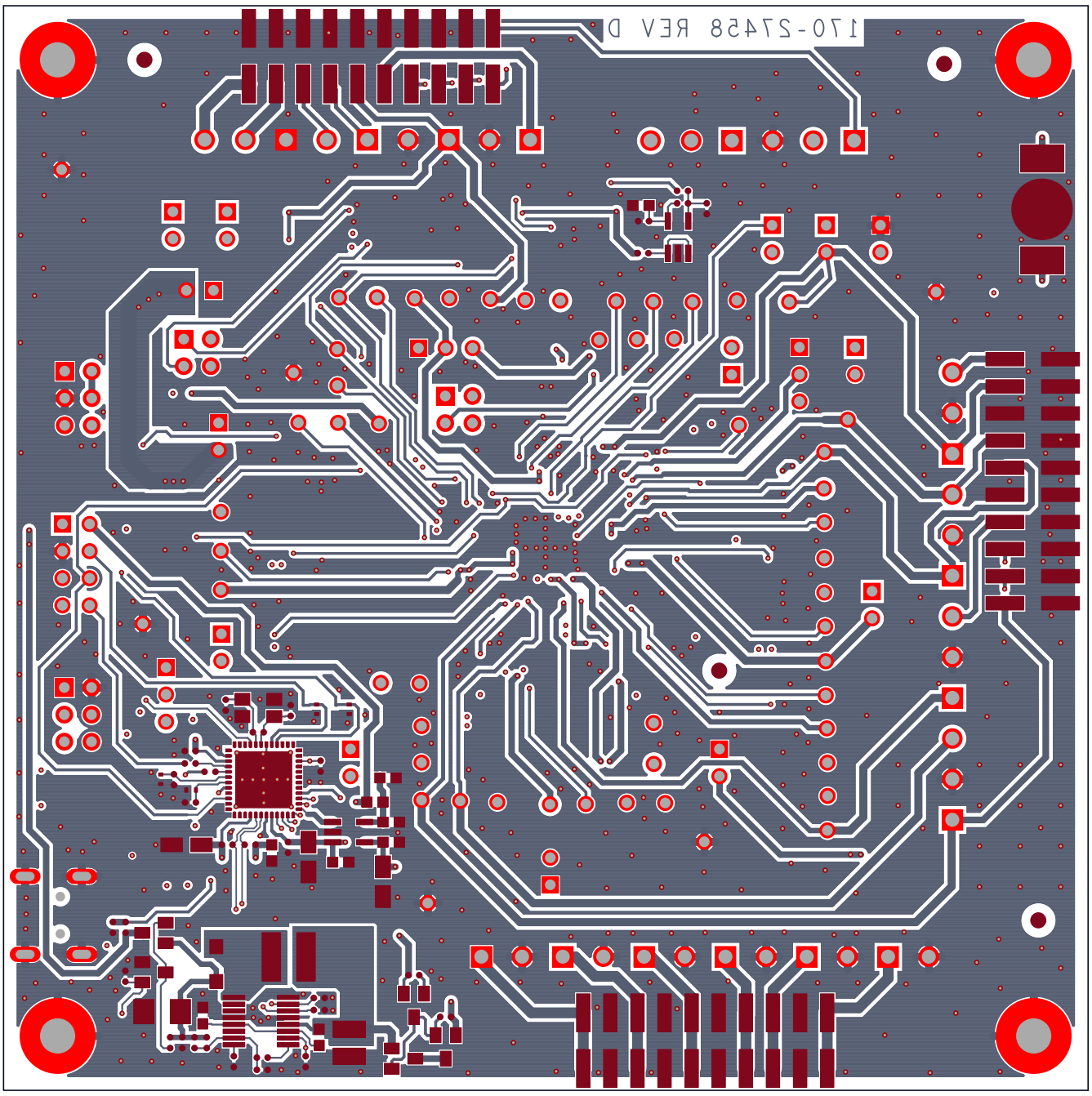


Figure 22. Bottom Layer Routing

12 Bill of Materials

Table 9. Bill of Materials [3]

Item	Qty	Notes	Schematic Label	Value/Description	Part Number	Manufacturer
1	1	[1]	BAT1	BATTERY LITHIUM -- 3.0V 5.5 MAH	MS621F-FL11E	SII MICRO PARTS LTD.
2	1	[2]	BAT2	HOLDER COIN CELL 6.8 MM SMT	BK-879	MEMORY PROTECTION DEVICES INC
3	7		C1, C3, C5, C8, C9, C12, C13	CAP CER 4.7 µF 10 V 10% X5R 0603		
4	7		C2, C6, C10, C11, C14, C44, C45	CAP CER 0.1 µF 10 V 10% X5R 0402		
5	5		C4, C7, C19, C56, C77	CAP CER 0.1 µF 10 V 10% X7R 0402		
6	1		C15	CAP CER 0.01 µF 50 V 10% X7R 0402		
7	14		C16, C21, C22, C25, C26, C27, C28, C29, C30, C31, C32, C33, C82, C83	CAP CER 22 µF 10 V 20% X5R 0805		
8	1	[2]	C17	CAP CER 1000 PF 50 V X7R 5% 0402		
9	1		C18	CAP CER 10 µF 10 V 10% X7R 0805		
10	5		C20, C34, C38, C42, C43	CAP CER 2.2 µF 6.3 V 20% X5R 0402		
11	1		C23	CAP CER 22 µF 10 V 20% X5R 0805		
12	1		C24	CAP CER 22 µF 10 V 10% X7R 1210		
13	2		C35, C41	CAP CER 4.7 µF 6.3 V 20% X5R 0402		
14	3		C36, C37, C39	CAP CER 10 µF 16 V 10% X7R 0805		
15	9		C40, C48, C49, C50, C51, C52, C54, C84, C87	CAP CER 1.0 µF 10 V 10% X5R 0402		
16	2		C46, C53	CAP CER 0.22 µF 16 V 10% X7R 0402		
17	1		C47	CAP CER 0.47 µF 10 V 10% X7R 0402		
18	1	[2]	C55	CAP CER 1.0 µF 10 V 10% X5R 0402		
19	5		C57, C58, C62, C63, C65	CAP CER 0.1 µF 16 V 10% X5R 0402		

Table 9. Bill of Materials [3] (continued)

Item	Qty	Notes	Schematic Label	Value/Description	Part Number	Manufacturer
20	1		C59	CAP TANT 10 µF 16 V 10% -- 3216-18		
21	3		C60, C61, C72	CAP CER 22 PF 25 V 5% C0G 0402		
22	1		C64	CAP CER 0.47 µF 16 V 10% X7R 0603		
23	1		C66	CAP TANT 4.7 µF 10 V 10% -- 3216-18		
24	1		C71	CAP TANT ESR 0.600 OHMS 15 µF 25 V 10% -- 3528-21		
25	1		C73	CAP TANT 4.7 µF 25 V 10% -- 3528-21		
26	1		C74	CAP CER 0.1 µF 25 V 10% X5R 0402		
27	1		C75	CAP CER 1.0 µF 25 V 10% X5R 0603		
28	1		C76	CAP CER 0.1 µF 6.3 V 10% X7R 0402		
29	2		C78, C86	CAP CER 470 PF 50 V 5% COG 0603		
30	1	[2]	C79	CAP CER 2.2 µF 16 V 10% X5R 0603		
31	1		C80	CAP CER 1.0 µF 16 V 10% X5R 0603		
32	1		C81	CAP TANT ESR=1.800 OHMS 2.2 µF 10 V 10% 3216-18		
33	1	[2]	C85	CAP CER 2.2 µF 6.3 V 20% X5R 0402		
34	1		D1	DIODE SCH PWR RECT 1A 20 V SMT	MBR120LSFT1G	ON SEMICONDUCTOR
35	3		D2, D3, D11	LED RED SGL 30 MA 0603	SML-LXFM0603SIC-TR	LUMEX
36	1		D4	LED DUAL GRN/RED 30 MA SMT	LTST-C195KGJRKT	LITE ON
37	4		D5, D6, D7, D8	DIODE TVS ESD PROT ULT LOW CAP 5-5.4 V SOD-923	ESD9L5.0ST5G	ON SEMICONDUCTOR
38	1		D9	DIODE SCH PWR RECT 1A 30 V SOD-123	MBR130LSFT1G	ON SEMICONDUCTOR
39	1		D10	LED GRN SGL 30 MA SMT 0603	SML-LXFM0603SUGCTR	LUMEX
40	1		F1	FUSE PLYSW 0.5 A 13.2 V SMT	MICROSMD050F-2	RAYCHEM
41	56	[2]	-	TEST POINT RED 40 MIL DRILL 180 MIL TH 109L		
42	14		J1, J2, J3, J4, J5, J6, J7, J9, J24, J26, J27, J40, J41, J47	HDR 1X2 TH 100 MIL SP 339H AU 118L		
43	9		J8, J10, J11, J12, J13, J14, J15, J31, J33	SUBASSEMBLY CON 1X2 TB TH 3.81 MM SP 201H -- 138L + TERM BLOCK PLUG 3.81MM 2POS		

Table 9. Bill of Materials [3] (continued)

Item	Qty	Notes	Schematic Label	Value/Description	Part Number	Manufacturer
44	7		J16, J18, J19, J21, J25, J29, J32	SUBASSEMBLY CON 1X3 TB TH 3.81 MM SP 201H -- 138L + TERM BLOCK PLUG 3.81MM 3POS		
45	2		J17, J35	HDR 2X3 TH 100 MIL		
46	3		J20, J22, J39	HDR 1X3 TH 100 MIL		
47	2		J46, J45	HDR 2x2 TH 100 MIL		
48	1		J34	CON 5 USB MINI-B RA SHLD SKT SMT 31 MIL SP AU	675031340	MOLEX
49	1		J36	HDR 2X4 TH 100 MIL		
50	3	[2]	J42, J43, J44	HDR 2X10 SMT 100 MIL		
51	1		L1	IND PWR 2.2 µH@100 KHZ 2.0 A 20% SMT	LPS3015-222ML_	COILCRAFT
52	1		L2	IND PWR 1.0 µH@100 kHz 6.0 A 20% SMT	XAL4020-102MEC	COILCRAFT
53	4		L3, L4, L5, L8	IND PWR 1.0 µH@100 KHZ 2.4 A 30% SMT	LPS4012-102NLC	COILCRAFT
54	1		L6	IND PWR 1UH@1MHZ 2.0 A 30% SMT	VLS252010T-1R0N	TDK
55	1		L7	IND PWR 1.0 µH@100 KHZ 2.65 A 20% SMT	LPS5015-102MLC	COILCRAFT
56	1		L9	IND FER 100 OHM@100 MHZ 8.0 A 25% SMD/1812	HI1812V101R-10	LAIRD TECHNOLOGIES
57	1		L10	IND PWR CHK 22 µH@1.0 KHZ 1.0 A 20% SMD	744773122	WURTH ELEKTRONIK EISOS GMBH & CO. KG
58	1		L11	IND FER 100 OHM@100 MHZ 8.0 A 25% SMD/1812	HI1812V101R-10	LAIRD TECHNOLOGIES
59	1		Q1	TRAN MOSFET DUAL N & P CHANNEL 2.5 V S-SOT6	FDC6327C	FAIRCHILD
60	2		Q2, Q3	TRAN PMOS SW 120 MA 25 V SOT23	FDV302P	FAIRCHILD
61	3		Q5, Q6, Q10	TRAN PMOS SW 2.0 A 30 V SSOT3	FDN360P	FAIRCHILD
62	2		Q8, Q9	TRAN NMOS 50 V 220 MA SOT-23	BSS138	FAIRCHILD
63	6		R1, R3, R4, R6, R8, R16	RES -- 0.001 OHM 1/4 W 5% 0805	LMI-R001-5.0	ISABELLENHÜTTE HEUSLER GMBH & CO. KG
64	1	[2]	R2	RES MF 1.0 OHM 1/16 W 1% 0402		
65	5	[2]P	R7, R9, R10, R17, R70	RES -- 0.001 OHM 1/4 W 5% 0805	LMI-R001-5.0	ISABELLENHÜTTE HEUSLER GMBH & CO. KG
66	1		R11	RES MF 0.001 OHM 1.0 W 1% 1206	CSNL1206FT1L00	STACKPOLE ELECTRONICS
67	5	[2]	R20, R23, R24, R27, R86	RES MF ZERO OHM 1/10 W 1% 0603		
68	5		R21, R22, R25, R26, R85	RES MF ZERO OHM 1/10 W 1% 0603		
69	2		R28, R41	RES MF 1.0 M 1/16 W 1% 0402		

Table 9. Bill of Materials [3] (continued)

Item	Qty	Notes	Schematic Label	Value/Description	Part Number	Manufacturer
70	2		R29, R79	RES MF 100 K 1/16 W 5% 0402		
71	3		R30, R31, R32	RES MF 10.0 K 1/16W 1% 0402		
72	3		R35, R73, R74	RES MF ZERO OHM 1/10 W -- 0402		
73	4		R36, R37, R50, R51	RES MF 4.70 K 1/16 W 1% 0402		
74	4		R38, R39, R40, R69	RES MF 200 OHM 1/10 W 1% 0402		
75	2		R42, R45	RES MF 33.0 OHM 1/16 W 1% 0402		
76	2	[2]	R48, R49	RES MF 1.5 K 1/16 W 5% 0402		
77	1		R55	RES MF 100 OHM 1/10 W 1% 0603		
78	1		R56	RES MF 604 K 1/16 W 1% 0402		
79	1		R59	RES MF 374 K 1/16 W 1% 0402		
80	2		R60, R76	RES MF 470 K 1/16 W 1% 0402		
81	1		R61	RES MF 120 K 1/16 W 1% 0402		
82	3		R63, R64, R65	RES MF 10 K 1/16 W 5% 0402		
83	2		R66, R75	RES MF 47 K 1/16 W 1% 0402		
84	2		R67, R68	RES MF 470 OHM 1/16 W 1% 0402		
85	1		R71	RES MF 20 K 1/10 W 5% 0603		
86	1		R72	RES MF 12.0 K 1/10 W 1% 0603		
87	2		R77, R78	RES MF 100 K 1/16 W 1% 0402		
88	1		R80	RES MF 27 K 1/16 W 5% 0402		
89	1		R81	RES MF 470 K 1/16 W 5% 0402		
90	3	[2]	R82, R83, R84	RES MF ZERO OHM 1/10 W -- 0402		
91	1	[2]	SW1	SW SPST PB 12 V 50 MA SMT		
92	1		U1	IC POWER MANAGEMENT CONSUMER/INDUSTRIAL QFN56	MMPF0200NPEP	FREESCALE SEMICONDUCTOR
93	1		U2	IC MCU 8BIT 48 MHZ 60 KB FLASH 2.7-5.5 V QFN48	MC9S08JM60CGT	FREESCALE SEMICONDUCTOR
94	1		U4	IC DAC CTRL BOOST INV +/-27.5 V -- 2.7-5.5 V QSOP16	MAX686EEE+	MAXIM
95	2		U5, U7	IC LIN VREG LDO 1.5-15V 150 MA 2.5-16 V SOT23-5	MIC5205YM5	MICREL
96	1		Y1	XTAL 12 MHZ SER 9.0 PF SMT	ECS-120-9-42X-CKM-TR	ECS INC. INTERNATIONAL

Notes

1. For critical components, it is recommended to use the manufacturer listed.
2. Do not populate
3. Freescale does not assume liability, endorse, or warrant components from external manufacturers that are referenced in circuit drawings or tables. While Freescale offers component recommendations in this configuration, it is the customer's responsibility to validate their application.

13 References

Document Number	Description	URL
MMPF0200	Data Sheet	http://cache.freescale.com/files/analog/doc/data_sheet/MMPF0200.pdf
MMPF0200ER	Errata	http://cache.freescale.com/files/analog/doc/errata/MMPF0200ER.pdf
PFSERIESFS	Fact Sheet	http://cache.freescale.com/files/analog/doc/fact_sheet/PFSeriesFS.pdf
AN4622	Layout Application Note	http://cache.freescale.com/files/analog/doc/app_note/AN4622.pdf
KTPFSWUG4	Software User Guide	http://cache.freescale.com/files/analog/doc/user_guide/KTPFSWUG4.pdf
	Product Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MMPF0200
	Tool Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=KITPF0200EPEVBE
	Analog Home Page	www.freescale.com/analog
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14 Revision History

Revision	Date	Description of Changes
1.0	2/2014	• Initial release

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